SMALL ORBITED PAYLOADS: A DEMAND ASSESSMENT

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Experimenters and sponsor organizations continue to express interest in flying small, often low cost payloads to orbit. Government procurement in the last several months have focused attention on prospects for expanding commercial activity in space. The interests and activity span many disciplines and applications, so a "payload" may be anything from an experiment apparatus that requires full spacecraft support (power, pointing, thermal protection, etc.) to a complete, self-contained satellite. Small packages fly now as secondary payloads on Shuttle or other large vehicles. Soon, however, these payloads may have several new options for rapid, low-cost access to orbit. The stated interest by experimenters and the development activity by launch services vendors raises questions about the size and nature of this demand. How large is the demand? How soon will it evolve to a sustained level of activity? To what degree is U.S. government participation required to assure development of U.S. space commerce?

SAIC has been active over the last year in a study sponsored by NASA that addresses the size and nature of demand for launching small (under 1000 kg) payloads to orbit in the next decade. We have made an extensive survey of prospective experimenters to ask about their interest in performing orbited experiments, how soon they could be ready to fly, and how often they would need reflight opportunities. Experimenters' interests must also be supported by funding, so sponsor organizations were asked to describe their program plans. U.S. vendors who have expressed interest in flying small payloads were asked to describe their launch services, costs, and planned annual launch capacity. A survey of experiment support requirements from prelaunch to end of mission (including recovery, if needed) allows comparison of payload support needs against hardware capability.

By direct contact with many representatives of payload fliers, sponsors, regulators, and services vendors, this study summarizes realistic expectations (as opposed to total market potential) of the nature and size of near-term demand for orbiting small payloads.

payload support needs, and permits a general comparison of support required with launch services capability.

The census of experimenters identified 332 separate payloads that, if funded, could be ready to fly in the 1990s. About 20% of these are payloads from foreign organizations, primarily in Canada and Europe. About 30% are payloads sponsored by various domestic military programs; the remaining 50% are sponsored by civilian government agencies or private resources. Although some are planned as fully integrated spacecraft that would require only launch services, most are just an experiment apparatus that must rely on an orbiter's support subsystems, perhaps sharing this bus with one or more other payloads. Many of the experiments included in this survey would require multiple flights to complete the research work. Including these reflight requirements, the payloads identified produce about 600 total "flight needs." However, because several experiments typically share a single bus, this need does not translate to a specific number of launches.

A sample of the domestic payloads surveyed indicates that the two discipline areas with the largest numbers of identified experiments are: (1) basic physics and astronomy, with sponsorship being shared by military and civilian programs, and (2) microgravity/materials processing, which is nearly all supported by civilian research. Figure 1 shows the results by broad discipline area for domestic payloads for which this information was available. The Communications

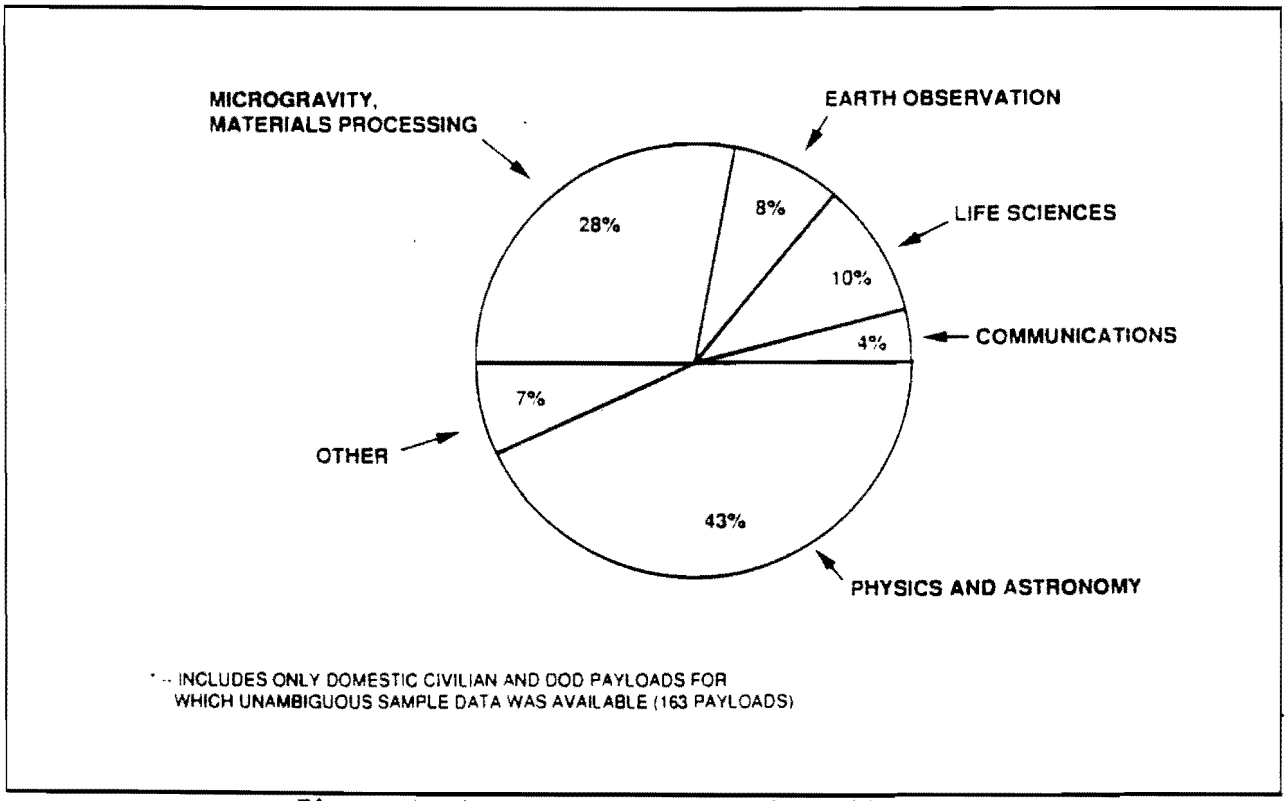

Figure 1 Survey results by discipline area

segment represents only identified applications or technology demonstration. Any research payloads supporting this area, such as atmospheric effects on signal propagation, are counted as physics experiments.

Considering hardware development costs for domestic users only, approximately 60% of the payloads are built wholly or partially by civilian government agencies; Department of Defense sponsors another 35%, so hardware developments funded exclusively by private capital make up less than 5% of the number of experiments surveyed. However, private funding also participates in co-sponsoring an additional 5% of payloads with civilian government, so private capital appears to be involved in building about 10% of the payloads identified. See Figure 2. These statistics are in terms of numbers of payloads and, therefore, do not reflect actual dollar investments by any of the sponsors;

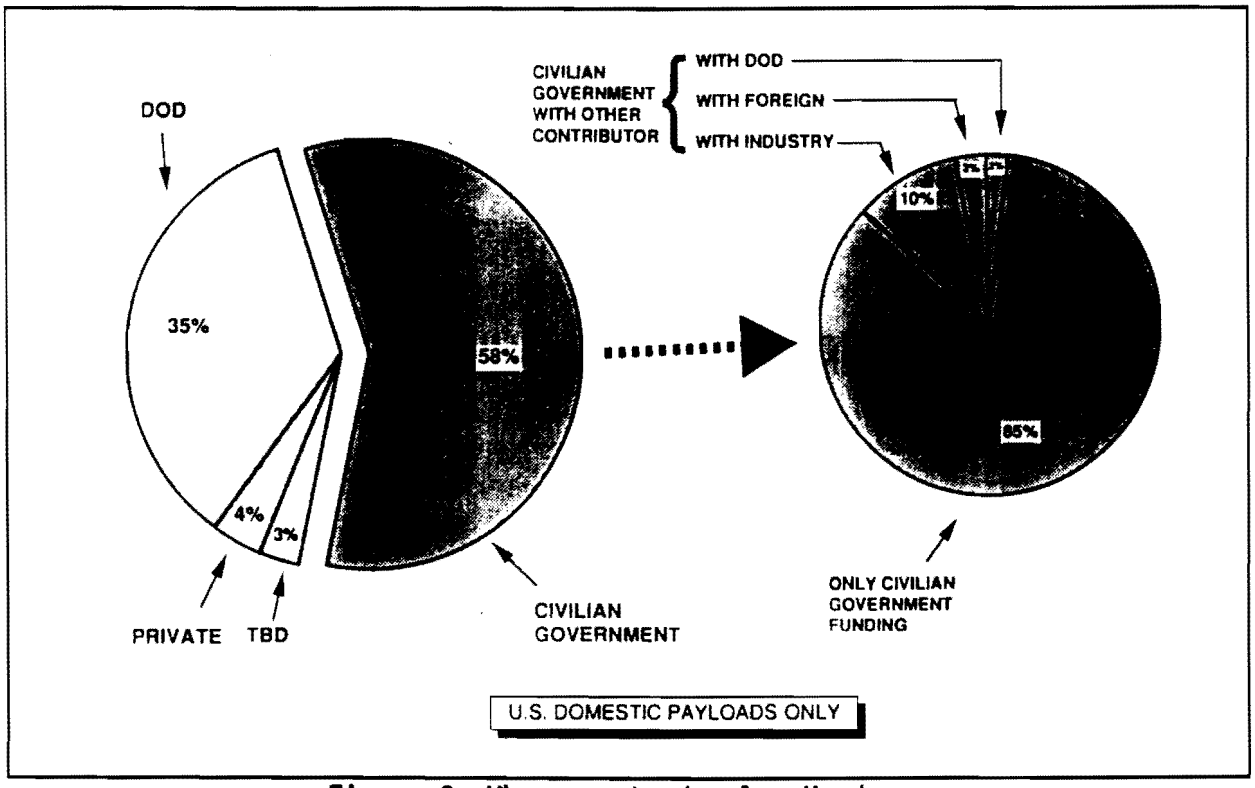

Figure 2: Who pays to develop Hardware

specifically, in-kind support and facilities sharing arrangements by industry are not included in this analysis.

Although the survey found over 300 potential payloads, our assessment indicates that only 15-20% of these will reach active flight-ready status, given current program plans and funding support from all sources. This estimate is partially confirmed by the survey response that 59 payloads (18%) are manifested now.

Just as a salesperson's many contacts usually result in a few buyers (Figure 3), so too do ideas for experiments become a smaller number of actual flights.

That observation should not surprise the reader; however, it is always a good idea to keep the assumptions and frame of reference clearly in mind when speculating about future events. Failure to do so usually results in

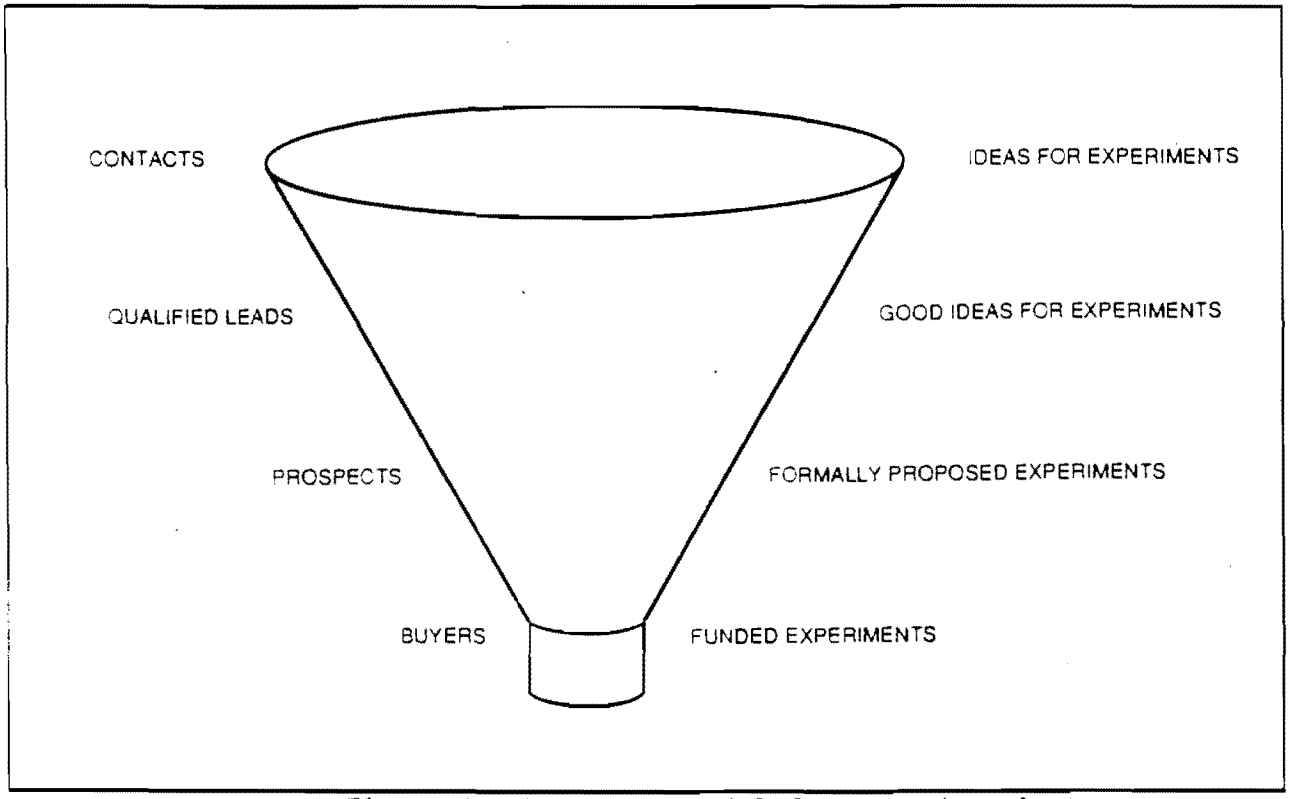

Figure 3 The funnel model for demand estimates

misinterpreted data and philosophical reflection about the value of hindsight.

By direct contact with many representatives of research organizations, payload sponsors, regulators, and services vendors, this study collected and summarized information about the nature and size of the near-term demand for orbiting small payloads. This view comes primarily from speaking with experimenters directly, wherever possible. The motivation for concentrating on experimenters rather than other participants was to understand demand from the point of view of those with a need for access to space. This information is key to preparation of realistic forecasts (as opposed to total market potential) of market opportunity for various commercial interests in small payloads. However, the long-term plans and funding constraints of sponsor organizations, and the directions, capability, and pricing policy of hardware and services vendors also play critical roles in building a complete understanding of market size and growth potential.